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**ON THE CONCEPT OF SIMILARITY
AND SOME IMPLICATIONS FOR ACCOUNTING THEORY**

Orace Johnson

#325

**College of Commerce and Business Administration
University of Illinois at Urbana-Champaign**



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Abstract

The sections of this paper deal in sequence with the philosophical concept of similarity; its relation to measurement theory and measurement scales; and their relation to accounting theory, with particular attention to measurement in terms of money and financial reports. Measurement is seen as a complex web of similarity relations between numerals, concepts, and real object characteristics. In accounting theory, the difference between price and value is emphasized. The conclusions are (1) that accounting for values can never be a scientific measurement discipline, and (2) that financial reports should be grounded on events theory with market price emphasis if accounting is to become more nearly a scientific measurement science.

ON THE CONCEPT OF SIMILARITY
AND SOME IMPLICATIONS FOR ACCOUNTING THEORY

The goal of this paper is to aid the cause of logical consistency in accounting theory through concern for the structure of what is (claimed to be) known rather than for heuristic operations. The precise use of crucial distinctions developed here will reduce conceptual vagueness and enhance logical consistency.

Consider the following example of conceptual error and its source. Time is often represented as an interval along a line, with the origin toward the left. Movement forward through time, say the period from 1776 to 1976, is depicted as movement from left to right between two points on the line. Thus, concepts of space are used by analogy to express concepts of time. Now, what about movement from right to left? The space/time analogy is not isomorphic. While we can move backward in space toward an arbitrary origin, we cannot move backward in time. Semantically, "backward in time" has no empirical referent. Syntactically, "backward in time" is a contradiction because "time" is defined as having a single direction of motion. (Notice the spatial overtones of direction and motion.) The conceptual error comes from transferring operations that are possible in one language erroneously onto the field of another language. A converse error would result if time, being defined as a vector, were used to represent space with a one-direction constraint.

The rules of one language, say mathematics, may permit certain combinations of signs that have no meaning when lifted into another language, say geography or account classification. The clarity of arithmetic calculations is liable to lead to confusion when the terms and relations of a math model are used to force

pieces of non-quantitative theory (i.e., the logic of categorical relations) into empirically meaningless propositions. That is to say, transferring the syntax of one language to speak of a representation in another language inevitably poses conceptual errors that may distort our organization of experience in the second language. Therefore we must avoid the mistake of mixing up the grammars of different language systems. Similarly, we must avoid the mistake of confusing any language for reality. For example, the representation of the earth by Mercator's projection could lead unskeptical explorers into some very strange polar experiences if they used the map literally to perceive Antarctica as the set of projected relations. The tyranny of such perception is an insane hubris whose cure is humility.

Likewise, the clarity of arithmetic calculations in computing debit and credit amounts for accounting can lead both theorists and practitioners into some strange polar extremes. Whereas the concrete materiality of Antarctica is demonstrably immune to any attempt toward verbal imposition of a geographical rearrangement based on Mercator's projection, the conceptual nature of categorical definitions and relations in the syntax of accounting is less resistant to mentally distorting impositions based on the grammar of mathematics. This lower resistance may help to explain recurrent attempts to define liabilities as negative assets [Ijiri, 1967, p. 71], and persistent difficulties in accounting for what-you-may-call-its [Sprouse, 1966].

Language translation is ambiguous and misleading if it allows terms and relations in formal mathematics to dominate the substantive thinking in accounting. This problem is particularly severe where the object or characteristic to be measured has not been satisfactorily identified. Unfortunately,

"The analogy [between one language instance and another] itself never shows that it is misapplied; this is shown only when the logic of the analogy is compared with the logic of the possibilities

it is used to describe, and such comparison is usually a tedious and difficult process." [Watson, p. 230]

A philosophical consideration of similarity can help us clarify such problems by providing a logical structure for their specific analysis. The following sections deal in order with kinds of similarity, measurement theory, measurement scales, and accounting theory with particular attention to monetary measurement.

KINDS OF SIMILARITY

In this section we distinguish among kinds of objects, kinds of characteristics, and kinds of relations.

Let the characteristics of a language fix the boundaries for a universe of discourse. Let the universe of discourse consist of three sets of substantially different kinds of reference objects which exist outside of language. These three sets are natural (including social) objects, artificial concrete objects, and conceptual objects. To illustrate these primitive terms, for "natural" object think of the Atlantic ocean; for "artificial concrete" object think of a ship; and for "conceptual" object think of a theory of navigation. Alternatively, think of a business entity, financial reports, and a theory of accounting.

Any object has two kinds of characteristics: inherent elements, and internal relations (both structural and functional). Just as one object can be an element intrinsic to an encompassing object, so a relation which is external to one system may be internal to a larger system. External or environmental relations are circumstantial and not characteristic. For example, the ownership relation between possessor and possessed is an external relation which is not

inherent or characteristic of either object. The term "property" will be used to express the relation of circumstantial ownership in contrast to the relation of inherent characteristics. An event is any change in characteristics or circumstances.

Just as there are no objects without characteristics, there are no independent characteristics. Thus we observe physical objects and objective relations, and then for measurement abstract from them the characteristics of major interest. When one object has a characteristic that is like a characteristic of another object, the two objects are said to be similar with regard to their common characteristic. This relation is sometimes referred to as "mapping." Two similar objects are "paired" with each other. These partners are said to "share" the same characteristic(s). A similarity relation is external to both partners, and characteristic of neither alone. Similarity is both factual and formal.

As to factual similarity, since either or both objects may be natural, artificial, or conceptual, there are six kinds of pairs. (There would be nine if sequence were relevant.) The similarity is "substantial" if both objects are natural, both artificial, or both conceptual. No special terms have been developed to denote each of the six kinds of factual similarity, perhaps because there is no inherent basis for rational ordering. Only an arbitrary, imposed sequence is possible for arranging the six kinds of factual similarity. Assume for the sake of an overly simple illustration in Table I that each object has a hole in it, and that this internal structure is the shared characteristic for similarity pairing.

As to formal similarity, considering the variety of human perceptions, at least three kinds may be distinguished. [Ackoff, 1962; Bunge, 1970]. If the relation is symmetric (like brotherhood), it is an analogy. If the relation is non-symmetric (like parenthood) it is simulation or copy. If the relation is

purely symbolic (like ">" or "\$") it is a representation or proxy. Analogy is strictly analytic, while simulation and representation are pragmatic. A copy may be useful in its own right; but a proxy is essentially semantic. Given the variety of human motivation and morality, the most useful proxy (representation) is not necessarily the simplest, easiest, or truest. It depends on the user and the used. The "most useful" for some (private or alleged public) goal may be a complex, difficult, lie. [Tabor, 1976] Equity Funding, Watergate, and CIA activities are good examples of misrepresenting representations. Misrepresentations can take two forms: the presence or the absence in the assertion of elements or relations that are, respectively, absent or present in the referent.

Unlike factual similarities, formal similarities are subject to ordering, both as to kind and degree. Bunge [1970, p. 30] discusses six degrees of formal similarity, as presented in Table II, from strongest (isomorphic) to weakest (plain). The same ordering holds for analogy, simulation, and representation. The strength of a similarity relation depends on the degree to which knowledge about the characteristics of one object conveys knowledge about the characteristics of the second object.

The five stronger degrees of formal similarity are all reflexive, transitive and class-equivalent for analogy, simulation, and representation. But the weakest similarity, plain analogy, is not sufficiently strong to establish a set or class of objects. Objects are very different if their only similarity is a plain analogy. The factual and formal aspects of similarity are positive characteristics of a conceptual relation between objects. Difference is not a positive characteristic and is understood only as the negation, opposite, or absence of similarity. Intentional misrepresentations assert non-existent similarity or deny existent differences, and conceivably range from the weakest

TABLE II

FORMAL SIMILARITY RELATIONS BETWEEN OBJECTS
BY KINDS AND DEGREES

KINDS OF FORMAL SIMILARITY

	ANALOGY	SIMULATION	REPRESENTATION
1 Isomorphic			
2 Homomorphic			
3 Bijective			
4 Injective			
5 Contagious			
6 Plain		(not defined)	

Degrees
of Formal
Similarity

TABLE II - continued

Definitions:

(1) Isomorphic, or perfect similarity exists when all properties (every element and relation) are paired exactly without exception.

(2) Homomorphic similarity exists when all properties (both elements and relations) of one object are present in the second object, but the second object is not thereby exhausted;

(3) Bijective similarity exists when only the elements in both objects are exhaustively paired, but their relations are not exhaustively paired;

(4) Injective similarity exists when all the elements of one object, but not the relations, are paired and the second-object is not thereby exhausted;

(5) Contagious similarity exists when only some characteristic(s) of each object are shared, either elements or relations.

(6) Plain analogy, the weakest form of similarity, exists when the relation is non-transitive; but it is the first step toward classification and generalization.

form of white lie to the strongest forms wherein isomorphism is totally violated. Relations cannot be classified with respect to differences except as a transformation of factual and formal similarities. To the extent that reference objects in discourse can be absolutely different, plain analogy is less than universal.

Considering both factual and formal similarity, there are conceivably at least 36 different analogies; 30 different simulations; and 30 different representations. That totals 96 as a theoretical maximum. However, since isomorphic (and perhaps homomorphic) similarity exists only for substantial relations, the practical maximum is 73. The context of a statement or question will not always unambiguously convey which similarity is being discussed. So in search of logical consistency, when things are said to be "like" each other, precise attention must be paid to critical analysis. This is of major practical importance in accounting measurement where economic consequences follow from surrogate/principal representations that range from deliberately phoney to fanciful to factually precise.

Bunge [1970. p. 34] indicates that the following mistakes can easily be avoided by referring to a framework which distinguishes among similarities:

- a) mistaking plain analogy for the far stronger (transitive) relation of class equivalence.
- b) speaking of isomorphism (or perfect formal analogy) when a much weaker relation (plain analogy) is involved.
- c) believing that a conceptual model or analogue to be true, must be a mirror image (bijective similarity) of its referent.
- d) believing that pictorial or visualizable models are essential to theoretical science--even when the referents are imperceptible, as is the case of electrons or nations.

Just as sets of objects may be classified by similarity relations, sets of relations (ownership, similarity, etc.) may be classified by their characteristics. For example, consider the formal similarity between the factual similarity relations in Table I. The formal similarity between factual similarities I (i.e., a hole in a rock and a hole in a bone) and III (i.e., a hole in astronomy theory and a hole in medical theory) is stronger than plain analogy (since I and III are both substantial relations) but weaker than homomorphic (since I is natural and III is conceptual).

We turn now to the relevance of similarity, as a philosophical problem, to measurement theory.

SIMILARITY AND MEASUREMENT THEORY

Even the simplest fundamental measure is a complex of many similarity relations. Too often isomorphism is blithely asserted rather than convincingly argued. Researchers too often fail to explain why a given relation among numerals necessarily represents a relation among natural objects. In consequence, numerically accurate calculation is too often mistaken for sufficient evidence of empirical correspondence. Too often we neglect a crucial part of Campbell's definition of measurement, [1920, 1928] namely that the assignment of numerals must be in virtue of laws governing the characteristics. It is not enough to be concerned only with the laws of numbers. Too readily we tend to forget Buchanon's insight [p. 95]:

"Magnitude as a property of things is a condensed result of analogical reasoning. When we ask, How much? the answer we expect and are satisfied with is a mathematical metaphor. Five pounds means that some physical object is to some other physical object (the standard weight) as five is to one."

The strength of a metaphor depends, like the strength of a chain, upon the weakest of its linking similarities. A lengthy derived (or secondary) measure could involve up to 73 different kind/degrees of similarities, and an even larger total of similarity instances. The final figure might be no stronger than a plain analogy if representativeness were not carefully guarded. It is, therefore, a gross simplification to say measurement is merely the assignment of numbers to things.

In this section we discuss the details of the measurement metaphor. Its complexity is suggested by Table III. (The relation between Table III, an artificial object, and the conceptual system of measurement is somewhere between contagious and homomorphic representation.) We start by examining the rows as systems, then the columns as elements, and then the content of cells.

Proceeding from top to bottom in the row captions, the universe of discourse has three objects and three relations represented by the single-headed vertical arrows. Artificial object systems such as numerals may represent conceptual objects such as numbers. This representation may be isomorphic, though not necessarily so. The ancient Greeks were handicapped because their arithmetic lacked a numeral to represent zero. In their universe of discourse, numerals were only homomorphic to numbers. Even without numeral representation, they did use the concept of zero implicitly as the base for counting--otherwise they could not have counted--and for higher arithmetical computations.

Next in turn, numbers may represent elemental and relational characteristics of both the number system itself and of other conceptual object systems. The factual relation between numbers and characteristics is substantial, since both are conceptual objects. Within the syntactic limits of language, and within the substantive limits of some theory, these relations are subject to stipulation and specification by deduction.

TABLE III

SIMILARITY RELATIONS IN MEASUREMENT

UNIVERSE OF DISCOURSE	CHARACTERISTICS SYSTEMS		ELEMENT		RELATION: Substantial Analogy		ELEMENT		RELATION: Substantial Analogy		ELEMENT		RELATION: Substantial Analogy		ELEMENT	
	ARTIFICIAL OBJECTS:	NUMERALS (NRS)	RELATION:	REPRESENTATION	↑	"0"	↔	↑	"1"	↔	↑	"x"	↔	↑	"x"	↔
	CONCEPTUAL OBJECTS:	NUMBERS	RELATION:	REPRESENTATION	↑	Zero	↔	↑	Unity	↔	↑	Measure	↔	↑	Measure	↔
	CONCEPTUAL OBJECTS:	SOME THEORY OF CORRESPONDENCE	RELATION:	REPRESENTATION	↑	Base	↔	↑	Standard	↔	↑	Subject	↔	↑	Subject	↔
	EMPIRICAL RELATION SYSTEM AMONG REAL WORLD OBJECTS	?	(0)	↔	?	(1)	↔	?	(x)	↔	?	(x)	↔	?	(x)	↔
	UNIVERSE OF REFERENTS	?	(0)	↔	?	(1)	↔	?	(x)	↔	?	(x)	↔	?	(x)	↔

Legend: Arrows signify similarity relations between adjacent objects (systems and elements)
Greek letters signify the relations in Buchanan's measurement metaphor.

Again in turn, conceptual characteristics may represent elemental and relational characteristics of, ultimately, artificial and natural objects. The rows of Table III do not show that some concepts may represent other concepts, but his simplification does not reduce the general nature of Table III for representing a broad understanding of the measurement metaphor.

Whereas the object rows have class names (numerals, numbers, characteristics, and real objects) the object columns are not classes and do not have class names. The arrows pointing upward in object columns 1, 3, and 5 represent the direction of representation: numerals represent natural objects, not vice versa, by way of conceptual relations. The object columns are related by substantial analogy, as represented by the horizontal doubleheaded arrows in columns 2 and 4.

In the first column, "0" is the symbol to represent zero. The quotation marks emphasize that the quoted content is here viewed strictly as symbolic. Zero is the conceptual starting point or base for counting. The real world phenomenon of nothing (the absence or void of some dimension) is designated by an unquoted 0. (The absence of quotation marks here is to emphasize that the referent of this sign is a real world phenomenon.) Similarly, in the third column, "1" is the symbol to designate the concept of unity, which is the standard for comparison. The real world referent or counterpart of this conceptual standard is 1. Finally, in the fifth column, "x" is the symbol to designate any numeral (say, "5") which is the representation of the number measure assigned to the subject being measured. Again, the real world referent, some tangible (natural or artificial) object or relation is designated by the unquoted X.

Thus, at a minimum 17 instances of similarity relations (all of the arrows in Table III) are behind any valid measurement statement that X is "x." This minimum will occur in the simplest fundamental measure of an extensive

characteristic of a tangible object. The assignment of numerals to other kinds of characteristics of intangible objects will involve more than 17 instances of similarity, with formal strength considerably less than homomorphic.

Measurement theory can be condensed (by paying attention to only the right three columns and glossing over the middle rows in Table III) to the deceptively simple operation, "assigning numerals to things." The Buchanan metaphor is itself a condensation of Table III: "1" is to "5" as one physical object (1) is to another physical object (5). Such a condensed theory of measurement leaves out the very grounds by consideration of which one could judge whether a measure is valid. Presuming isomorphism to exist between a numeral relation system and an empirical relation system is not a safe shortcut. Such presumption ignores the fact that background theory is essential to substantiate the abstraction of characteristics for measurement.

Four factual similarity relations in the universe of discourse stand out as immediate problems in measuring. These are labeled in Table III as follows:

- (α) The substantial analogy between the standard and subject;
- (β) The substantial analogy between two magnitude concepts;
- (γ) The representation of the standard by the unity concept;
- (δ) The representation of the subject by the magnitude concept assigned as its measure.

Each of the four factual similarities will have one of five or six possible degrees of formal similarity, from plain to isomorphic.

"The fundamental problem of epistemology," according to Caws [p. 250] "is exactly to discover on what grounds we may assume that connections and tendencies in the mind are reflections of connections and tendencies in the world." And as Bunge emphasizes [1970, p. 30], "Outside mathematics, isomorphic representation seems to be an unattainable ideal--a goal that one strives for, hoping

to come closer to it well knowing that it cannot be reached." The characteristics of language (as a universe of conceptual objects for discourse) are substantially different from the characteristics of reality (as a separate universe of natural and artificial objects to which language may refer). The only perfect similarity that man can demonstrate is a relation between conceptual objects. Therefore, an example of impossibly pure idealism is "an accounting system...contemplated which is isomorphic with the system of actual events which impinge directly on an entity." [Chambers, p. 126]

It is not valid to claim isomorphism between a numeral relation system and another relation system unless, as concepts, they are perfectly paired in all characteristics. If an empirical relation system is thought to be one of real world objects existing outside and only referenced by the universe of discourse, then measurement is not isomorphic because conceptual and physical (natural or artificial) objects are substantially dissimilar. Otherwise, if the empirical relation system is thought to be one of abstracted characteristics of conceptual objects, then measurement of real referents is at best hypothetical. This quandry cannot be avoided by defining "measurement" operationally for two reasons: (1) only statements, and not terms, can be made to correspond to operations [Bunge, 1967, p. 143], and (2) a definition is a relation of substantial analogy between signs rather than a representation. Representation by a sign of its referent object is a referential, and "any definition of a word denoting an external thing must ultimately rely on pointing at such a thing." [Polanyi, 1967, p. 5] The goal of theory is a better conceptual representation of a real (extra-lingual) system. This representation can be only hypothetical and never substantial because the nature of language is not the same as the nature of reality.

The following basic questions must be answered in any thorough analysis of a measurement metaphor:

- (1) Are the concepts of zero and unity in the number system accurately paired with the conceptual base and standard?
- (2) Do the concepts of base and standard have real world referents?
- (3) What scientific theory establishes the existence of an empirical (real world) relation system?
- (4) What numeral scale (nominal, ordinal, interval, or ratio) is most similar to the variation in the empirical (real world) relation system?

With these questions in mind, we now consider further the relation between similarity relation systems and measurement scales.

SIMILARITY AND MEASUREMENT SCALES

Artificial objects, such as Arabic or Roman numerals, may represent conceptual elements and relations of the number system. In turn, numbers are useful representations because they can refer to magnitude characteristics of conceptual systems which in turn represent objects in the real world. A language of some numeral relations system ("NRS") is useful as science when it represents an extra-lingual, real world empirical relations system (ERS) of natural objects. Meaning (CRS), a conceptual relation system, is attached to the numeral artifacts (as description, explanation, prediction, or prescription) in the understanding with language which mediates natural and artificial objects. "Only believers in the magical power of signs can hold that signs have a value [meaning] in them." [Bunge, 1967, p. 135]

Mattessaich has hinted that the number system can be viewed as a conceptually perfect taxonomy. "While the horizontal dimension of different sets or classes can be well expressed by any kind of symbolism, we know of no other efficient system to express simultaneously also the vertical dimension of classes, sub-classes, sub-sub-classes, etc." [pp. 62-63] In a base-10 numeral system representation of the number system, the emissive taxons for sequentially finer partitions are called "tenths," "hundredths," "thousandths," etc. Cutting across this vertical dimension, each taxon is a set of exclusive classes that exhaust the conceptual universe, unity, and are ordered from zero. Computational effectiveness is due to this absolute reference base. Computational efficiency is gained by the syntactics of integer placement which was first developed by the Babylonians with a base 60 system [Kline, p. 14-15]. Without these taxonomic properties, functional relations in the number system (as represented by artificial objects such as "+," "-", "x," "÷," "=", etc.) would be meaningless, and measurement operations (such as add, subtract, multiply, divide, equals, etc.) would be impossible. Without taxonomic properties of both horizontal and vertical class relations, measurement scales would be meaningless and useless for mediating between numerals and the magnitude characteristics of extra-lingual objects.

Measurement theory since Stevens [1946, 1959] has often divided scales into four kinds. According to Mattessaich [p. 59] it is:

"a matter of opinion which jump is regarded to be the critical one in determining what constitutes measurement and what not: the step from verbal description to numerical classification, that from the nominal scale to the ordering of classes by means of the ordinal scale, or that from the latter to a scale which enforces regularity of class-internal..., or even the step from

the interval scale to a ratio scale which requires a zero-point that is not arbitrarily chosen but given somehow beyond mere convention."

Such opinion, however, ought to be grounded on some criteria for rational choice. The concept of similarity and its diverse forms provides such grounding. If the taxonomic interpretation of categorical relations among numbers is accepted, the ordinal, interval, and ratio scales can be seen as subsets of the larger concept, classification.

However, numerals in nominal usage do not systematically represent numbers. Nominal numerals only tag objects with names. The only systematic difference between different names is difference itself, which is not a positive relation. Since there is no magnitudinal relation among numerals considered as names only, the nominal "scale" cannot express any class relation among referent objects. The nominal "scale" is not even plain analogy because there is no relation among numerals considered as names only. [Torgerson, p. 52] Since numerals as name labels do not represent any concept that is similar to any characteristic of the objects being named, no transitive characteristic for determining class equivalence is represented by a nominal "scale." The use of a nominal "scale" does not qualify as measurement if the purpose of measurement is to represent a given relation among characteristics by the predetermined relation among numbers. Indeed, nominal usage of numerals should not even be called a "scale" if "scale" implies some relation among the elements of NRS.

The ordinal and interval scales represent classification by relative rank and relative distance. The ratio scale is used for all operations which are, in ordinary usage, described as measures. According to classical measurement theory, there is a happy conjunction between this ordinary usage and rigorous

discrimination among terms because only numerals assigned with a ratio scale should properly be called measures. Even the most elementary measuring operation, counting discrete recurrences, requires the reference base, zero, for the numerals to represent magnitudes. Non-representative manipulation of numerals may be an interesting, information enterprise in itself, but no calculation representing extra-lingual operations is possible with numeral relations restricted to ordinal or interval characteristics because all kinds of statistical measures require for their computation a ratio scale [Lim, p. 643]. Modern measurement theory tends to neglect this requirement.

If the use of numerals as names, ranks, intervals, or measures is not to lead us into error and absurdity, the qualitative differences among objects being represented must be examined carefully. (Mattessich, for example, [p. 62-63] mistakenly interpreted the place-holding usage of numerals as consistent with a nominal, rather than ordinal, scale. Place is an ordinal concept.)

The problem of whether a particular scale ("NRS") can yield a valid measure (ERS) depends upon what can be done with the scale rather than upon what can be done to it. This distinction between the events of doing to and doing with has generally been overlooked in the accounting literature on measurement. (For example, see AAA (1971) p. 312). Inherent characteristics of an object are discovered through study of what can be done to it. Environmental or circumstantial relations are discovered through study of what can be done with it.

Consider the following illustration.

Morphological transformations of water establish its natural definition as an object considered in its own right apart from any question of usage. Things that can be done to water include these changes in the internal relations among elements:

- (1) creating it (by burning hydrogen and oxygen)
- (2) freezing it (by lowering its temperature below 0° centigrade)
- (3) evaporating it (by exposing it to an unsaturated atmosphere)
- (4) contaminating it (by solution or suspension of foreign elements)
- (5) decomposing it (by electrolysis into hydrogen and oxygen)

Operational manipulations of water and its transformations are viewed as tools for accomplishing purposes. Placement, movement, and containment are circumstantial and as such do not change the nature of water. Things that can be done with water include these external, circumstantial relations:

- (1) traveling (by swimming in it, skating on it or other propulsion)
- (2) drinking (by swallowing the liquid form)
- (3) bathing (by contamination)
- (4) air cooling (by evaporation)
- (5) selling (by exchanging legal ownership)

Similarly, measurement scales can be done to or done with. By analogy, if numbers are useful tools for measuring, then numeral scales should be classified according to what can be done with them. Only the ratio scale can be used for computing statistics since only it has a natural reference base. Computing statistics is not something that can be done with an ordinal or interval scale. (Similarly, drinking water cannot be done with evaporation.)

This distinction between with and to is exemplified by the difference between tables IV and V. Table IV is a reproduction of Mattessich's (p. 70) adaptation from Stevens. The heading precisely and correctly summarizes the contents: "Examples of Statistical Measures Applicable to Measurements Made On the Various Classes of Scales." Table V is a rearrangement of Table IV to precisely and correctly summarize the "Examples of Statistical Measure Computable With Various Classes of Scales."

TABLE IV

Examples of Statistical Measures Applicable to
Measurements Made on Various Classes of Scales

Classes of Scales				
				Ratio
Classes of Statistics			Interval	
	Ordinal			
	Nominal			
Measures of Location	Mode	Median	Mean	Geometric Mean Harmonic Mean
Dispersions	Information	Percentiles	Standard Average Deviation	Percent Variation
Association as Correlation	Information Transmitted (T) Contingency Correlation	Rank-Order Correlation	Product-Moment Correlation; Correlation Rank	---
Significance Tests	Chi Square Test	Sign Test Run Test	Critical Ratio Test t Test F Test	---

TABLE V

Examples of Statistical Measures Computable
with Various Classes of Scales

Classes of Scales Classes of Statistics				
	Nominal	Ordinal	Interval	Ratio
Measures of Location				Mode; median; Arithmetic mean Geometric Mean Harmonic Mean
Dispersions				Information (H) Percentiles Standard Deviation Percent Variation
Association				Information Transmitted (T) Contingency Correlation Rank-Order Correlation Product-Moment Correlation Correlation Ratio
Significance				Chi-Square Test Sign Test Run Test Critical Ratio Test t Test F Test

This section has thus shown that (1) the structure of valid measurement may be construed as a rich composite of similarity relations, that (2) anything less rigorous than a ratio scale weakens the representation by a numeral of its referent, and that (3) the subject on which a measure is made must be specified in a theory context. With the hope that the term "measurement" need not degenerate into a buzzword that has lost its rigorous meaning, we turn in the final section to measurement and accounting theory.

MEASUREMENT AND ACCOUNTING THEORY

While recent use of the term "measurement" in accounting has included non-monetary items, the argument here is restricted to units of money. The focus is on the fundamental function of money in an exchange economy, namely as a medium for indirect rather than barter exchange. Money is a social object representing the indirect exchange ratios of all economic goods and services. Monetary price is an observable characteristic of the market. The other two functions of money, as a standard of value and as a store of value, are derivative, secondary, and not observable. Chambers [1965, p. 39] says exchange is the only function of money, and certainly if money had no use in exchange (as in a non-market or a barter economy) it would have no use as a standard or store of value, and hence no service potential. Monetary value is not characteristic of the market, but rather a stipulated attribute of some conceptual relation. Statements of value are incorrigible assertions, while statements of price are testable propositions. The terms "price" and "value" have been used in accounting literature with at least four different semantic relations: (1) as definitional synonyms, ("Value is price"); (2) as surrogation ("Value is measured by price"); (3) as functional relations ("Values determine price" or "prices

determine value;" and (4) as substantially different and independent concepts, the usage here.

This fundamental/derivative split in the functions and interpretations of money is reflected in the difference between the events approach to accounting theory, which is primary, and the value approach, which is secondary. [Sorter, 1969; Johnson, 1970] This split can be illustrated by quotations from Paton and from Littleton.

Paton wrote [1922, p. 433] "The crux of accounting theory and accounting practice...is valuation." That idea does indeed dominate present thinking, but it rests on a fundamental misunderstanding of the relation between money and the various objects being accounted for. That similarity relation is the central applied issue of this paper. The misunderstanding of the value approach to accounting theory is the assertion of unwarranted similarity relations--plain analogies or loose fictions masquerading as strong representations of accurate facts.

Littleton wrote in his final publication [1970, p. 471] "Mutual acceptance [of a market exchange transaction] creates an indisputable, quantitative fact. That [event] fact is not *value*; it is *price*...emerging...from separate valuation judgments satisfactory to both parties."

Both event theory and value theory must deal with the summation problem. That aspect of measurement is not a fundamental difference between them. As Churchman observed [1959, p. 89] about measurement, "One wants to be able to assert that [object] x has [characteristic] property y under conditions z at time t ." For accountants the measurement problem is compounded because financial reports sum across objects, across characteristics, across conditions, and across time. The concern in this paper is much deeper than the question of whether a monetary characteristic meets the requirements for additivity.

The central questions are these:

"Of what objects are monetary measures truly characteristic, and what characteristic of money do numbers of dollars (or of any other numeraire) truly represent?"

Vickrey [1976, p. 32] reasoned as follows:

"...if the numerical assignments of a given accounting system are shown to be inconsistent with the rules of measurement theory, then the implication is that we should be pessimistic about the relevance of these values in the development of a scientific theory of accounting (because values such as these generally are of limited value in scientific theorizing)."

His argument needs to be extended one level deeper toward a bedrock foundation for accounting theory. If none of the numerical assignments in terms of money comply with the rules of measurement theory, then there can be no scientific theory of accounting that has explanatory, predictive, and descriptive powers like those disciplines usually accepted as being sciences. The rules of measurement to which a scientific theory system must comply include the constraints of both the numeral relation system and the empirical relation system. That is, to be a science, accounting theory must justify both aspects of measurement, NRS and ERS, with CRS that is a strong representing relation.

I propose that whatever validity may reside in the language of mathematics (NRS) the nature of money (ERS) precludes financial accounting from ever becoming a measurement science if accounting is concerned with valuing assets, equities, and entities.

For example, consider price-level adjustments. The argument is made [e.g., Moonitz, 1970, pp. 465-466] that the difference between historical cost numerals

and price-level-adjusted numerals has no more significance than the difference between meters and feet or kilos and pounds, all three being pure scale transformations with no change in the phenomena being represented by numerals. But such argument has the following error: the phenomena represented by numerals, market relations, do change, with both particular and general significance. Length and weight are inherent elemental characteristics of natural and artificial concrete objects. Money is a relational characteristic of the market, a social object encompassing owners and possessions. The monetary relation (price) is internal to specific markets, but external to both the owners and the exchangeable possessions. Both present and potential owners may attribute service potential (expected monetary value in use) to the exchangeable objects. But value attributions are ownership concepts and not characteristics of either markets or exchangeable objects. The possibility of valid scale transformations from one NRS to another does not in itself establish the accuracy of an incorrigible CRS (subjective monetary values) as a representation of an ERS (objective market prices).

Vickrey's concern for additivity is warranted only if--as many authors state or imply--money is a characteristic of the objects in financial reports (that is, assets, equities and entities), or if the various markets from which prices are taken are sufficiently similar and stable. But neither of these conditions hold. Price is a relation between exchangeable items within a market system, and neither prices nor values are stable.

Consider the market relation of one dime and two nickels. In barter terms, one dime exchanges for two nickels. But two nickels is not a characteristic of the dime. In monetary terms, with the dollar as numeraire, the price of both the dime and the two nickels is ten cents. The monetary price, ten cents, is a generalized relation characteristic of some markets. In different markets

under different circumstances, the dime might exchange for a diamond; but the diamond would not be a characteristic of the dime, and neither the dime nor the diamond would be a characteristic of the two nickels or of the entity owners. Whether the summation of several market relations from various times and places might be an index representing some other market relation is strictly a pragmatic problem and cannot be described accurately as a scientific measurement problem.

Two issues arise from the pragmatic interpretation of monetary summation indices. How accurately do prices (the internal exchange relations of a set of markets) represent values (the various external relations between owners and possessions)? How accurately does the mind of the accountant or accountant preparing the reports represent the minds of numerous different users? Both questions have the same answer: Not necessarily very well, and possibly not at all.

Though the term "current value accounting" is now popular, emphasis on any value theory which focuses on subjective expectations of service potential is a weaker justification for either exit or entry prices than is event theory which focuses continuously on market exchangeability. Indeed, the very nature of money is an argument supporting accounting reports that emphasize current market prices. Summations of current market prices are likely to be more accurate predictors of future market relations than summations of obsolete historical costs because the probability of empirical error varies directly with lapsed time.

The predictive validity test has been offered as guide to scientific choice when two information systems both pass all the tests for logical validity. But since no financial accounting system can pass the logical tests of measurement science, the predictive validity test may guide a pragmatic choice between

information systems that equally fail the tests of logical validity. Debates over "measurement theory" aspects of historical cost and price-level-adjustments are futile, if not altogether irrelevant. Money does not "have" generalized purchase power as a characteristic. Money by definition is generalized purchase power, and financial reports should emphasize by separate disclosure the distinction between monetary amounts as ERS (summations of prices from many markets) and CRS (calculations of alleged values.)

Concern for value in accounting has led to legalistic, conventional, authoritarian GAAP calculations. Concern for price may lead to scientific, reasoned, empirical GAAP observations. In value theory, objectivity is just a constraint on the use of models. [Penman, 1970] But in event theory, objectivity is an inherent, determinant part of the model emphasizing market price relations.

CONCLUSIONS

No one has a right to claim to know the size, shape, color, position or value of things which by their nature cannot bear such characterization. [Margenau, 1972, p. 10] Attributing smell to a beam of light is no less inaccurate a characterization than attributing value to assets, equities, or entities. Costs do not attach and "as if" analogies do not constitute scientific measurement representations.

The simplistic view that dollars measure assets and equities may contribute to the criticism that accounting reports with only monetary data are inadequate. The unwarranted interpretation that value is a characteristic of assets and equities may enforce allegations that GAAP are not useful for decisions. Whether there is any similarity between summations of past or present

market relations and markets for different properties at different times and places is strictly a question of index usefulness. It is not a question of scientific measurement.

Consistent emphasis on accounting reports as summations of market relations (prices, not values) can serve to distinguish unbiased accountants from charlatans since the former will sometimes discipline their professional practice with a little reflection on (1) the categorical difference between price and value, (2) the instability of both price and value in a monetary exchange economy, and (3) the tenuous similarity between value attributions by various accountors, countees, and accountants.

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